Southeastern Wisconsin Regional Planning Commission

SEWRPC

Waukesha County Stormwater Workshop

March 21, 2018

#00227979

- What is a datum?
  - A system that serves as basis for survey measurement and calculations
  - Part of the system requires a spheroid that fits the surface of the earth well.
  - Datums are made visible on the surface of the earth in the form of monuments

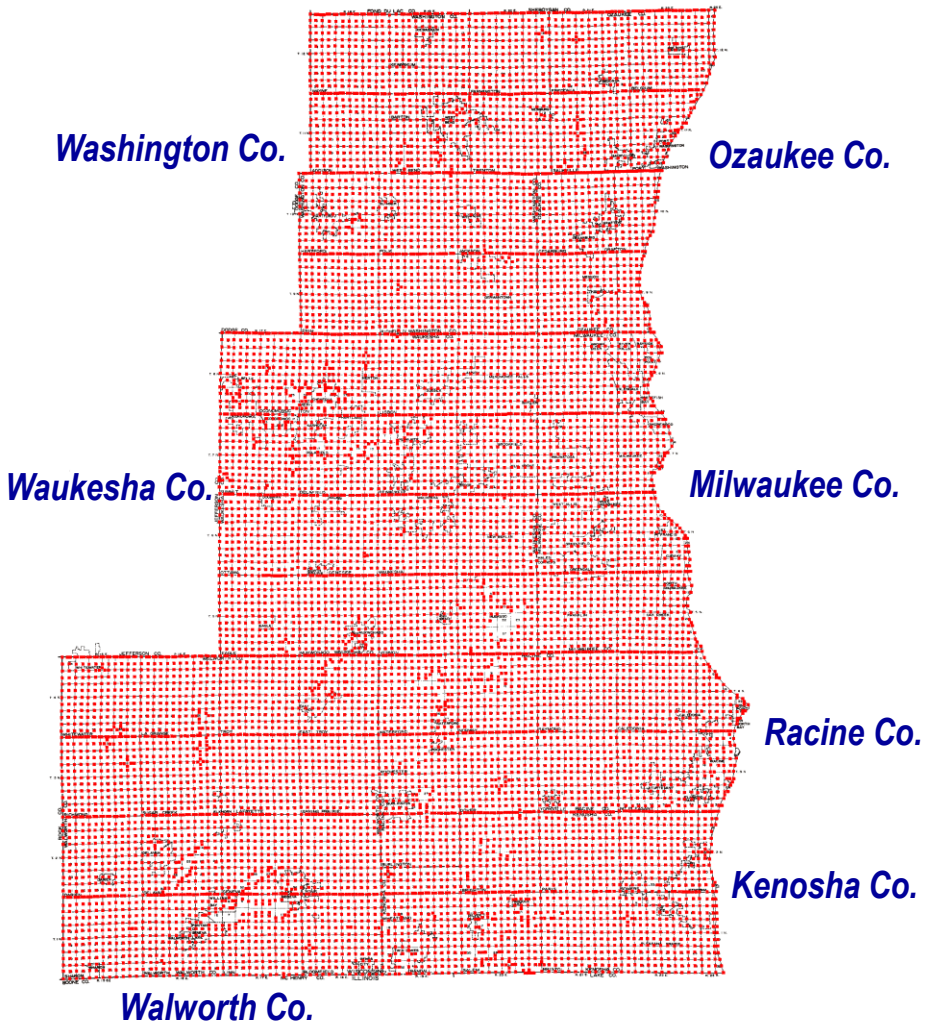
Datum

- Two main types of positional datums.
  - Horizontal datums provide a basis for describing positions (latitude and longitude) on the surface of the Earth.
  - Vertical datums provide a basis for describing land elevations and water heights or depths.

Southeastern Wisconsin Region

- Since 1961 – The Commission recommended NAD 27 and NGVD 29 datums
- In Southeast Wisconsin these physical monuments consist of marking the U.S. Public Land Survey System and bench marks
- The Commission created a high-order control network by combining USPLSS corners

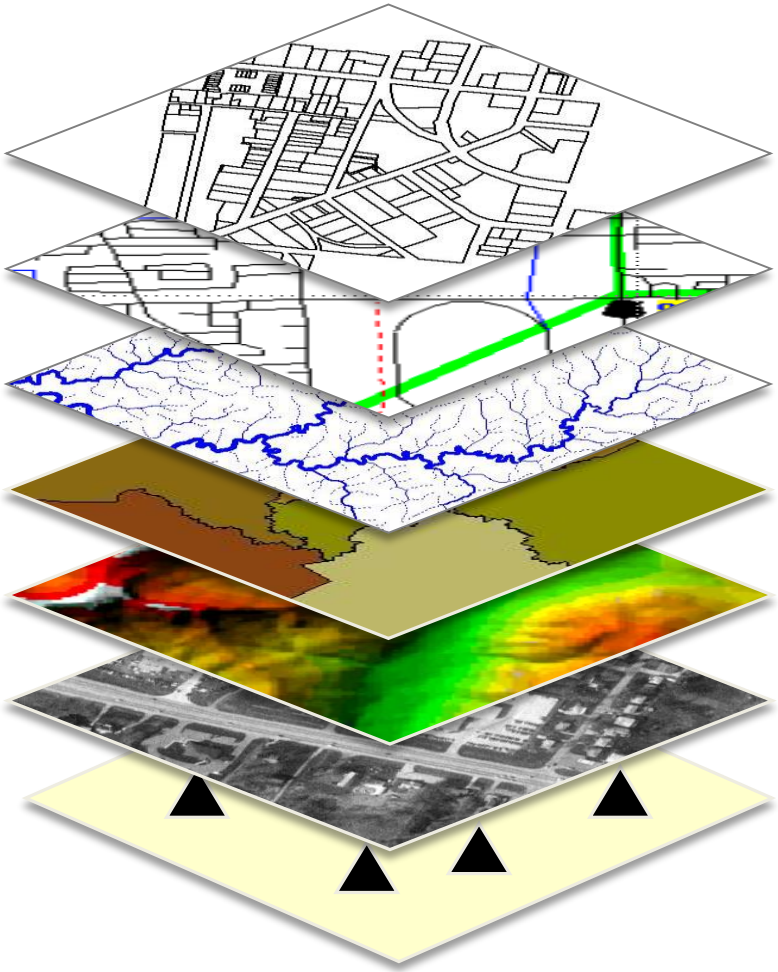
Current Assets – PLSS Corners



Total Corners by County	
Kenosha	1,203
Milwaukee	1,065
Ozaukee	1,064
Racine	1,478
Walworth	2,503
Washington	1,905
Waukesha	2,535
Region Total	11,753

Due to the need to set witness corners, the 11,753 corners are marked by 11,985 monuments.

Datum provide the foundation for all surveying and mapping and the creation of Land Information Systems



Land Ownership

Transportation

Surface Waters

Boundaries

Elevation

Aerial Imagery

Geodetic Control

Question

Do we convert to NAD83/NADV88?

What would be the process?

Observe All

- Option 1
  - 2012 – Commission Prepared Memorandum Report No. 206
    - "Estimate of Costs of Converting the Foundational Elements of the Land Information and Public Works Management Systems in Southeast Wisconsin from Legacy to New Datums"
  - NAD27 to NAD83 (2011) & NGVD29 to NAVD88
  - 11,753 Corners would have to be resurveyed for new horizontal and vertical positions
  - Horizontal Accuracy is 2nd Order, Class I (1:50,000)
  - Vertical Accuracy is maintained at 2nd Order, Class II
  - Horizontal estimated costs were $2.3million
  - Vertical estimated costs were $6.7mil

New Approaches to NAD83 & NAVD88

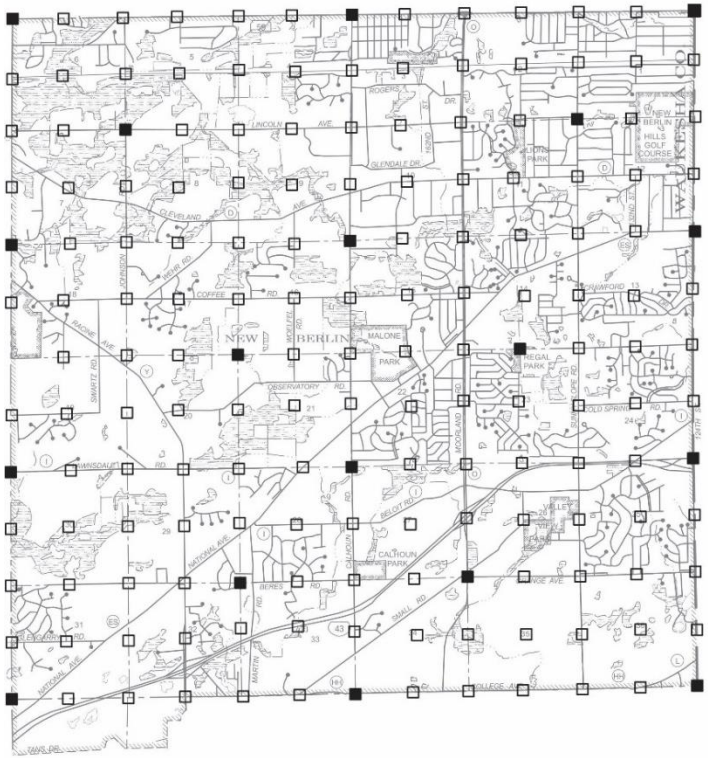
- Option 2
  - 2015 - Commission staff undertook a reevaluation of Memorandum Report No. 206.
  - Commission Staff Developed New Procedures for both Horizontal and Vertical Datum Conversions – Described in an Addendum Memorandum Report No. 206
  - Not a complete resurvey – Utilizes legacy measurements
  - Horizontal Accuracy is maintained 3rd Order (1:10,000)
  - Vertical Accuracy is maintained 2nd Order, Class II
  - Horizontal estimated costs $400k
  - Vertical estimated costs $300k

Horizontal

- Observe a minimum number of corners on new datum using Global Positioning System (GPS) measurements
- Uses measurements made in creation of legacy horizontal control survey network
- Compute position of the remaining control stations using the legacy measurements and limited number of surveyed corner positons

Horizontal

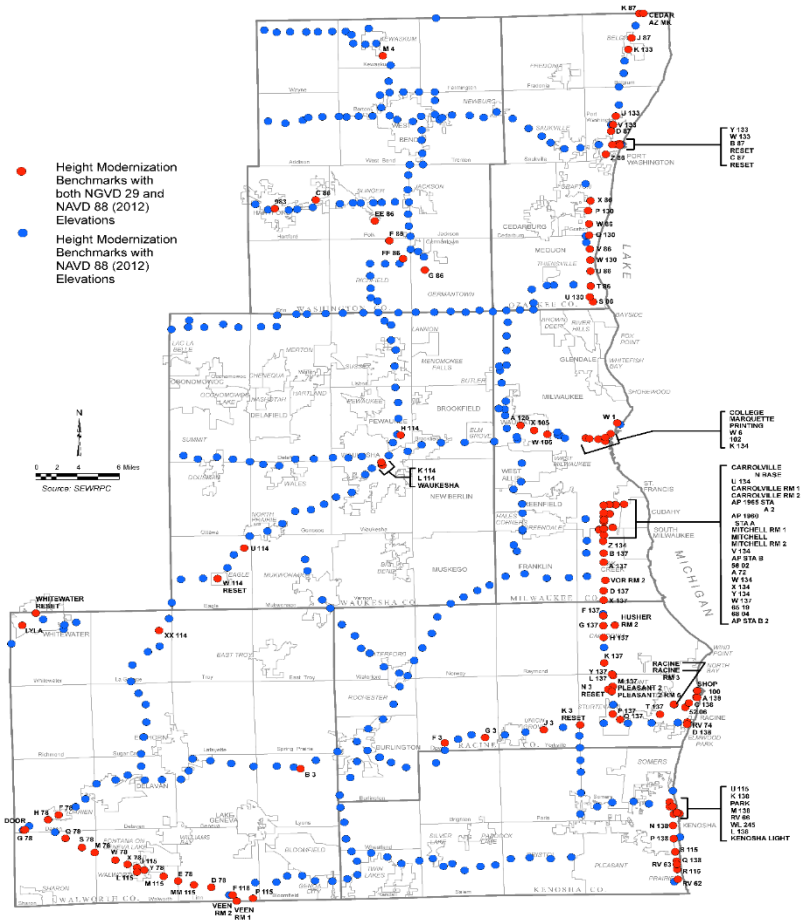
Black squares are resurveyed positions marks
Open squares are computed positons marks



Source: SEWRPC.

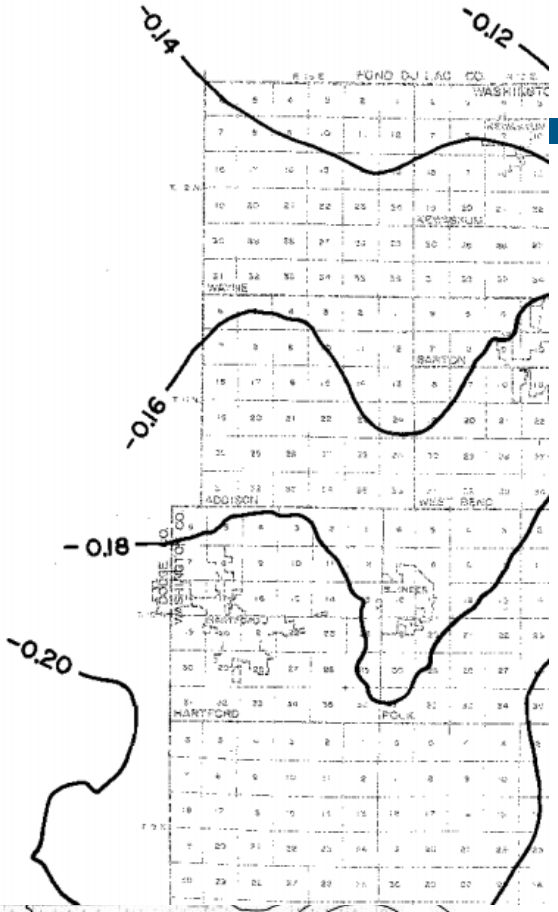
Vertical Conversion

- Utilize the comprehensive legacy vertical network
- Transfer field survey elevations referred to the legacy datum to the WI-HMP bench marks.
  - Transfer should require no more than the completion of approximately half-mile differential level line for each transfer
- Prepare an Iso-hypsometric map based the orthometric and elevation differences computed on each WI-HMP bench mark



Map 2

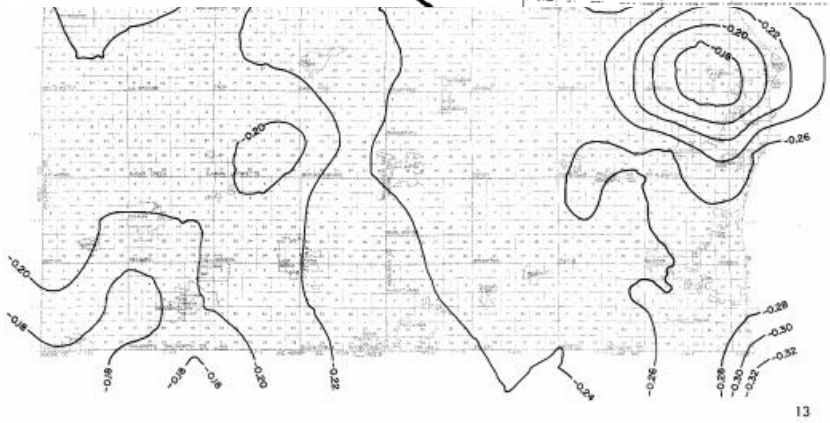
ISO-HYPSOMETRIC MAP OF VERTCON 2.0 PREDICTIONS FOR SOUTHEASTERN WISCONSIN



LEGEND

LINE OF EQUAL DIFFERENCE IN ELEVATION BETWEEN NAVD 88 AND NGVD 29 VERTICAL DATUMS

-0.24 DIFFERENCE IN ELEVATION IN FEET (NAVD 88 MINUS NGVD 29)



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Waukesha County Conversion to NAD 83(2011) and NAVD88

Waukesha County - Critical Phases

- Data mining from existing dossiers – In Progress
- Input of Legacy Measurements – Nearing Complete
- 1st Adjustment to verify input of legacy measurements – In Progress
- GPS Observations – Not Started
- NAD83 Adjustment using observed GPS data
- Finalize Observed and Computed Corners
- Preparation of CSSDs

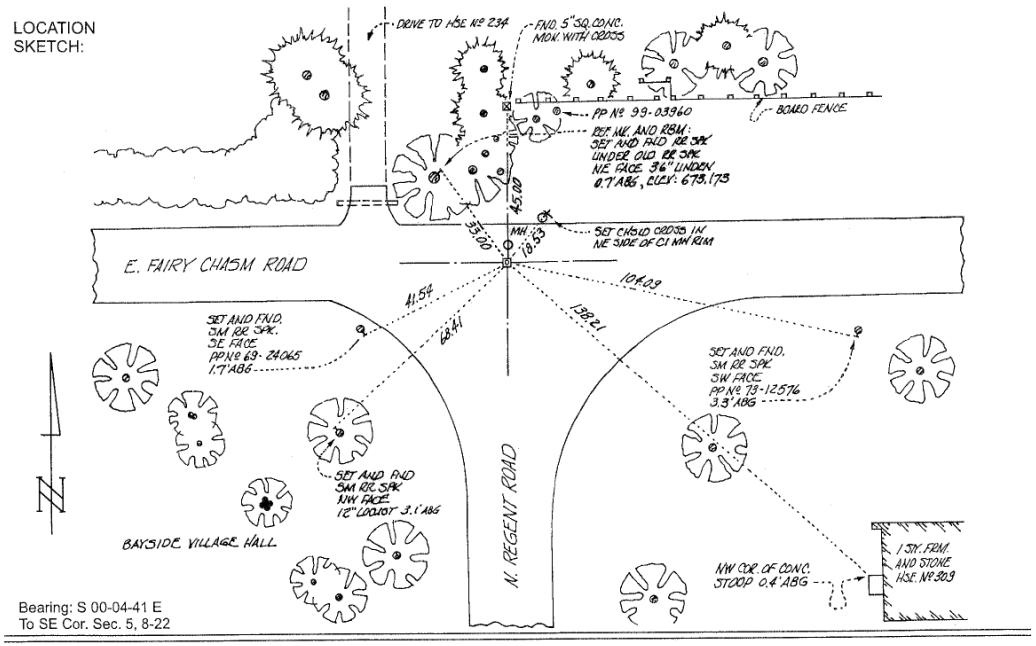
RECORD OF U.S. PUBLIC LAND SURVEY CONTROL STATION

U.S. PUBLIC LAND SURVEY CORNER 5|4 / 5|4 T 08 N, R 22 E, Milwaukee COUNTY, WISCONSIN

HORIZONTAL: NORTH AMERICAN DATUM OF 1927	HORIZONTAL: NORTH AMERICAN DATUM OF 1983/2011
VERTICAL: NATIONAL GEODETIC VERTICAL DATUM OF 1929	VERTICAL: NORTH AMERICAN VERTICAL DATUM OF 1988 (12)
HOR. CONTROL: AERO-METRIC ENGINEERING, INC. 1996	HOR. CONTROL: SEWRPC 2017
VERT. CONTROL: SEWRPC 2004	VERT. CONTROL:
NORTHING: 438,515.16 USFT	NORTHING: 438,524.73 USFT
EASTING: 2,558,727.91 USFT	EASTING: 2,527,189.42 USFT
ELEVATION: 672.399 FT	ELEVATION: FT
HOR. ACCURACY: 3rd ORDER, CLASS I	HOR. ACCURACY: 3rd ORDER, CLASS I (COMPUTED)
VERT. ACCURACY: 2nd ORDER, CLASS II	VERT. ACCURACY:

RBM ELEV. IN SKETCH BELOW TIED TO NGVD29 DATUM. CONVERSION FROM NGVD29 _____ FT DERIVES NAVD88 HEIGHT

LOCATION SKETCH:



SURVEYOR'S AFFIDAVIT:

STATE OF WISCONSIN)
MILWAUKEE COUNTY) SS

As Milwaukee County Surveyor, I hereby certify that following street reconstruction, I set a concrete monument with SEWRPC brass cap to mark the location of this corner; replacing a broken concrete monument; said concrete monument with SEWRPC brass cap having been found and referenced by me as Milwaukee County Surveyor on October 14, 2004, and having been set to mark the location of this corner by me as Milwaukee County Surveyor on October 24, 1989; replacing a broken concrete monument; said concrete monument with Village of River Hills brass cap having been set to mark the location of this corner in March 1966 by Wallace G. Nienow, S-175; replacing an old, subsurface, five-inch-square, cut limestone monument with cross set to mark the location of this corner circa 1860 in the conduct of the remonumentation of the Town of Milwaukee; replacing in turn a wood post set to mark this corner in February 1835 by William A. Burt, Deputy United States Surveyor, in the conduct of the original United States Public Land Survey; that I have referenced the same as shown hereon; and that this record is correct and complete to the best of my knowledge and belief.

WISCONSIN K.W. BAUER S-157 LAND SURVEYOR

DATE OF SURVEY: 3 September 2010 Kurtis W. Bauer S - 157

REGISTERED LAND SURVEYOR

FORM PREPARED BY SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION (SEWRPC)
CERTIFICATION APPLIES ONLY TO THE LOCATION SKETCH AND SURVEYOR AFFIDAVIT

08220180 18 –

RECORD OF U. S. PUBLIC LAND SURVEY CONTROL STATION

U. S. PUBLIC LAND SURVEY CORNER 5|4 5|4 T 8 N, R 22 E, MILWAUKEE COUNTY, WISCONSIN

HORIZONTAL CONTROL SURVEY BY: AERO-METRIC, INC. YEAR: 1996
VERTICAL CONTROL SURVEY BY: SEWRPC YEAR: 2004

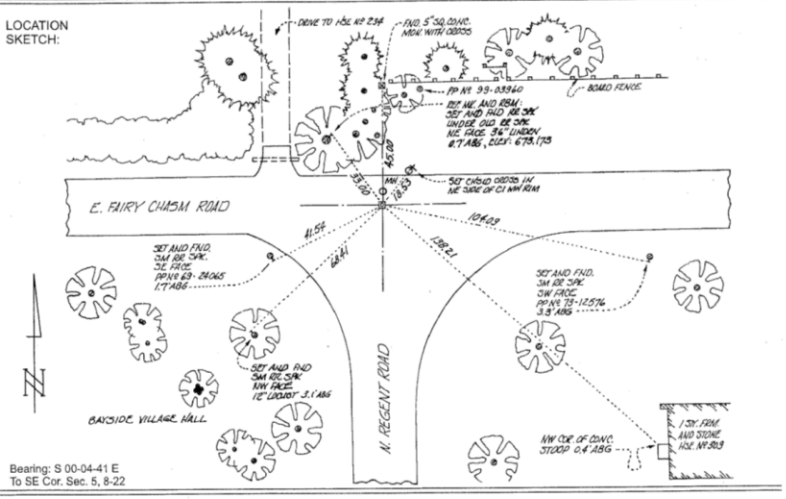
STATE PLANE COORDINATES OF: QUARTER SECTION CORNER
NORTH 438,515.16
EAST 2,558,727.91
ELEVATION OF STATION: 672.399

HORIZONTAL DATUM: WISCONSIN STATE PLANE COORDINATE SYSTEM, SOUTH ZONE NORTH AMERICAN DATUM OF 1927

VERTICAL DATUM: NATIONAL GEODETIC VERTICAL DATUM OF 1929 THETA ANGLE: +1-26-20

CONTROL ACCURACY:
HORIZONTAL: THIRD ORDER, CLASS I VERTICAL: SECOND ORDER, CLASS II

LOCATION SKETCH:



Bearing: S 00-04-41 E
To SE Cor. Sec. 5, 8-22

SURVEYOR'S AFFIDAVIT:

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MILWAUKEE COUNTY) SS

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REGISTERED LAND SURVEYOR

FORM PREPARED BY SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

18

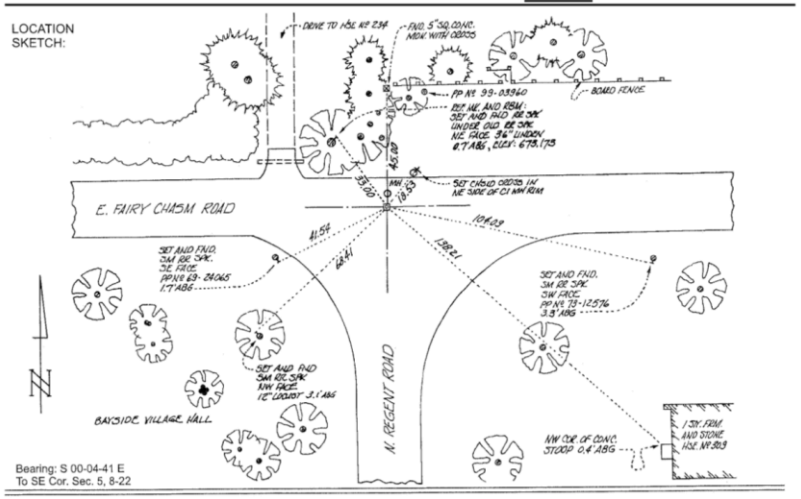
RECORD OF U.S. PUBLIC LAND SURVEY CONTROL STATION

U.S. PUBLIC LAND SURVEY CORNER 5|4 5|4 T 08 N, R 22 E, Milwaukee COUNTY, WISCONSIN

HORIZONTAL: NORTH AMERICAN DATUM OF 1927	HORIZONTAL: NORTH AMERICAN DATUM OF 1983/2011
VERTICAL: NATIONAL GEODETIC VERTICAL DATUM OF 1929	VERTICAL: NORTH AMERICAN VERTICAL DATUM OF 1988 (12)
HOR. CONTROL: AERO-METRIC ENGINEERING, INC. 1996	HOR. CONTROL: SEWRPC 2017
VERT. CONTROL: SEWRPC 2004	VERT. CONTROL:
NORTHING: 438,515.16 USFT	NORTHING: 438,524.73 USFT
EASTING: 2,558,727.91 USFT	EASTING: 2,527,189.42 USFT
ELEVATION: 672.399 FT	ELEVATION: FT
HOR. ACCURACY: 3rd ORDER, CLASS I	HOR. ACCURACY: 3rd ORDER, CLASS I (COMPUTED)
VERT. ACCURACY: 2nd ORDER, CLASS II	VERT. ACCURACY:

RBM ELEV. IN SKETCH BELOW TIED TO NGVD29 DATUM. CONVERSION FROM NGVD29 FT DERIVES NAVD88 HEIGHT

LOCATION SKETCH:



Bearing: S 00-04-41 E
To SE Cor. Sec. 5, 8-22

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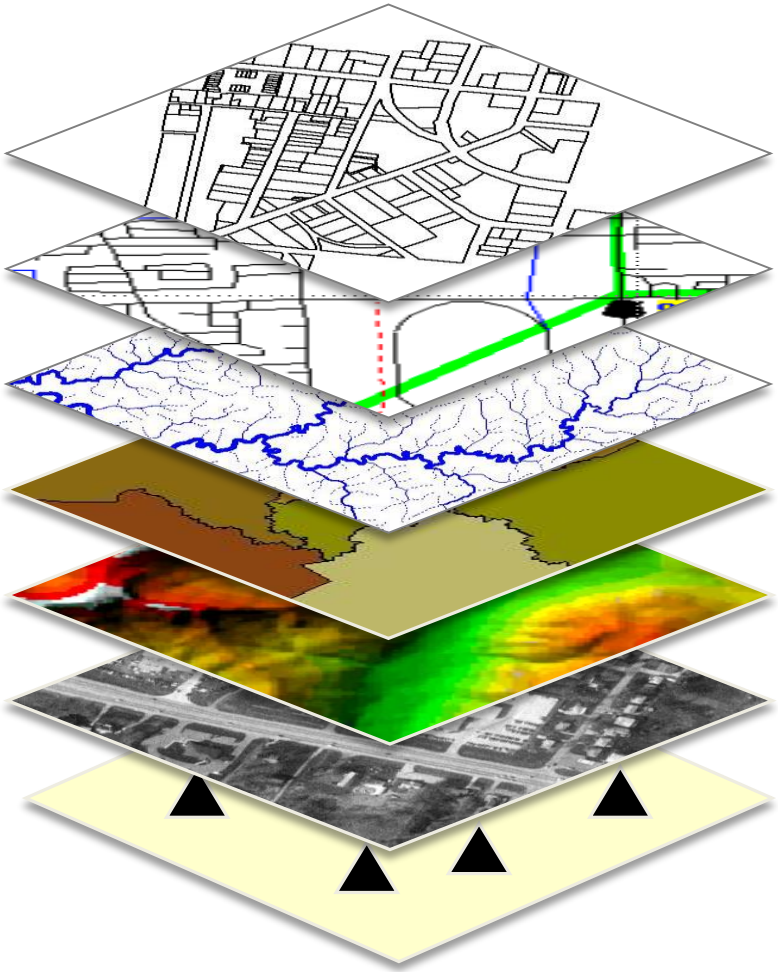
CERTIFICATION APPLIES ONLY TO THE LOCATION SKETCH AND SURVEYOR AFFIDAVIT

08220180 18 –

Datum provide the foundation for all surveying and mapping and the creation of Land Information Systems



Parcel Data

Transportation

Surface Waters

Boundaries

Elevation

Aerial Imagery

Geodetic Control

Converting Base Mapping Layers

Vector and Cadastral Files

- Create a separate testing area
- Check your transformation options
- Check the transformation empirically using a 3rd party software (i.e. CORPSCON, GEOCON, etc.)

Imagery

- Create a separate testing area
- Check on input datum of image header file and output datum to ensure proper transformation
- Transformed pixels will be non-orthogonal…This will require one to output

- Base Mapping Transformation
  - ArcMap - No transformation going from NAD27 to NAD83(2011)…very important!
  - So how do we transform the Vector/Raster Datasets?
    - 2D Transformation; 7-parameter transformation; etc.
    - Stock ArcMap transformation parameters in ArcMap

Empirical Testing

				Adjusted		Difference	
	NAD27			NAD83(2011)		NAD27-NAD83(2011)	
Point No.	Northing	Easting		Northing	Easting	Northing	Easting
04200010	313347.89	2517629.61		313358.010	2486092.380	-10.120	31537.230
05171440	313295.32	2391088.00		313304.507	2359550.962	-9.187	31537.038
05200090	344428.42	2495691.48		344438.321	2464154.949	-9.901	31536.531
07170830	390831.19	2411112.00		390839.612	2379574.266	-8.422	31537.734
08170130	439342.28	2390418.36		439349.760	2358880.700	-7.480	31537.660
08200010	440481.93	2516440.16		440490.244	2484902.126	-8.314	31538.034
					Average:	-8.904	31537.371
					RMSE:	8.952	31537.371

Empirical Testing

	Adjusted			Corpscon / ArcMap		Difference	
	NAD83(2011)			NAD83(HARN)		Corspcon-Adjusted	
Point No.	Northing	Easting		Northing	Easting	Northing	Easting
04200010	313358.010	2486092.380		313358.199	2486092.738	-0.189	-0.358
05171440	313304.507	2359550.962		313303.661	2359550.610	0.846	0.352
05200090	344438.321	2464154.949		344438.250	2464154.293	0.071	0.656
07170830	390839.612	2379574.266		390839.305	2379574.692	0.307	-0.426
08170130	439349.760	2358880.700		439349.273	2358881.148	0.487	-0.448
08200010	440490.244	2484902.126		440490.580	2484902.135	-0.336	-0.009
					Average:	0.198	-0.039
					RMSE:	0.447	0.421

Empirical Testing

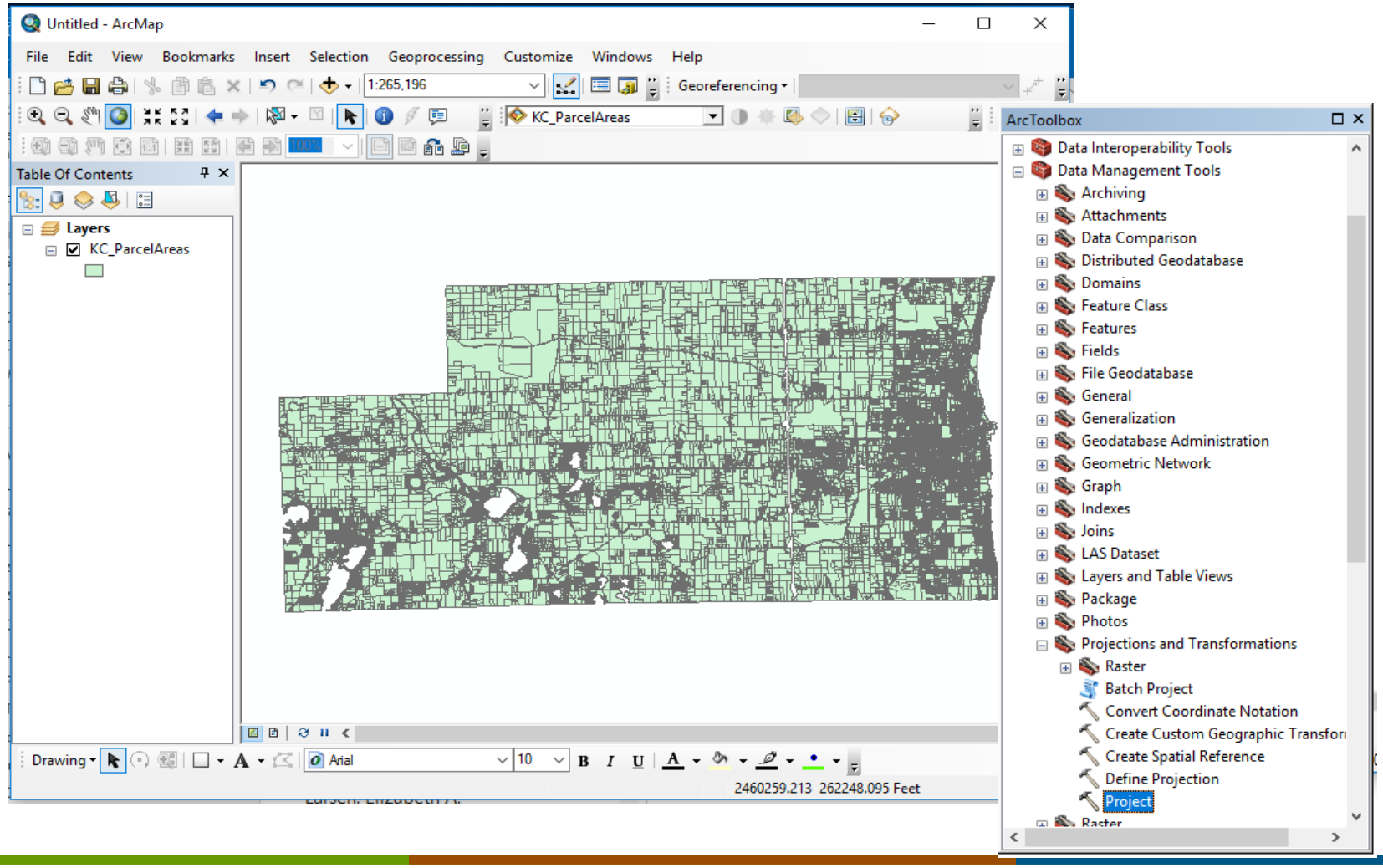
	Adjusted			GeoCon		Difference	
	NAD83(2011)			NAD83(2011)		Geo(2011)-Adjusted	
Point No.	Northing	Easting		Northing	Easting	Northing	Easting
04200010	313358.010	2486092.380		313358.501	2486092.918	-0.491	-0.538
05171440	313304.507	2359550.962		313303.803	2359550.724	0.704	0.238
05200090	344438.321	2464154.949		344438.678	2464154.429	-0.357	0.520
07170830	390839.612	2379574.266		390839.481	2379574.995	0.131	-0.729
08170130	439349.760	2358880.700		439348.714	2358881.69	1.046	-0.990
08200010	440490.244	2484902.126		440490.202	2484901.913	0.042	0.213
					Average:	0.179	-0.214
					RMSE:	0.574	0.602

Empirical Testing

	Adjusted			Corpscon / ArcMap		Difference	
	NAD83(2011)			NAD83(1986)		Corp(83/86)-Adjusted	
Point No.	Northing	Easting		Northing	Easting	Northing	Easting
04200010	313358.010	2486092.380		313357.196	2486091.745	0.814	0.635
05171440	313304.507	2359550.962		313303.059	2359550.081	1.448	0.881
05200090	344438.321	2464154.949		344437.311	2464153.420	1.010	1.529
07170830	390839.612	2379574.266		390838.538	2379574.097	1.074	0.169
08170130	439349.760	2358880.700		439348.477	2358880.629	1.283	0.071
08200010	440490.244	2484902.126		440489.555	2484901.436	0.689	0.690
					Average:	1.053	0.662
					RMSE:	1.084	0.819

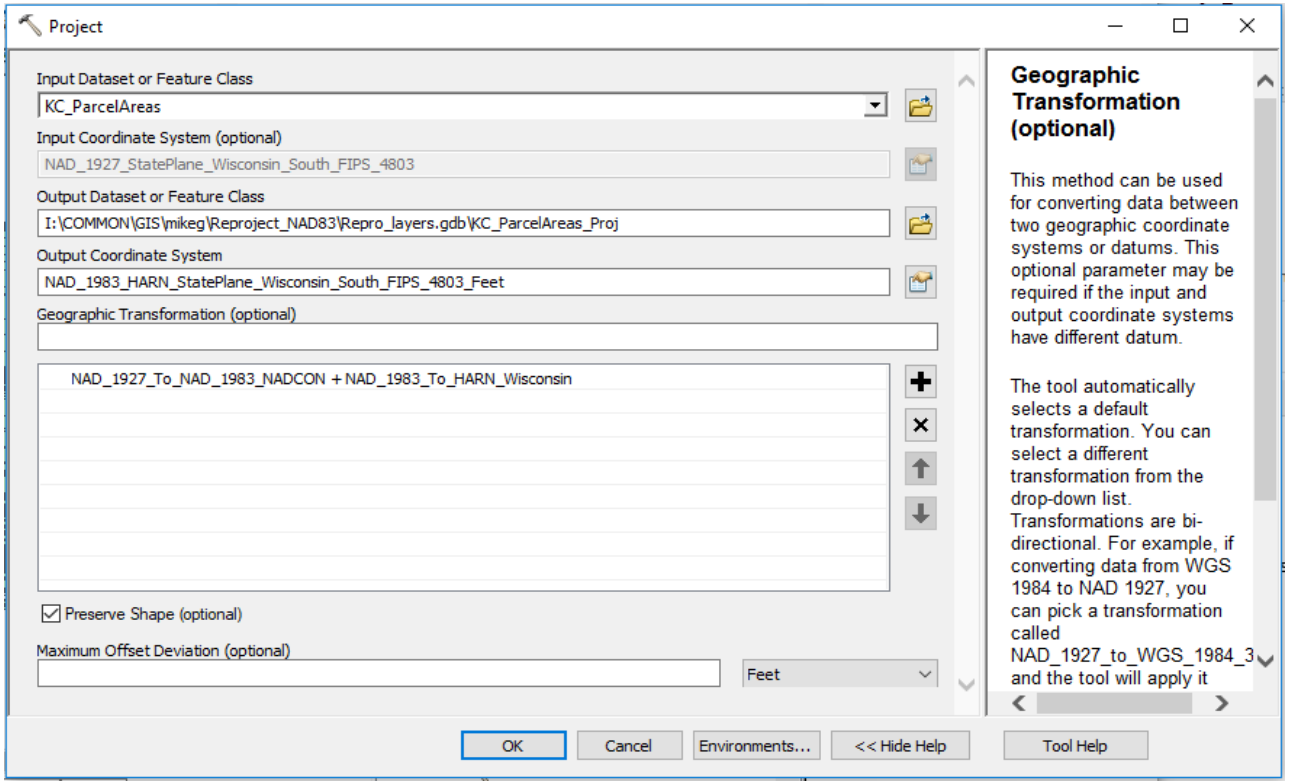
	Difference		Difference		Difference	
	Corspcon-Adjusted		Geo(2011)-Adjusted		Corp(83/86)-Adjusted	
Point No.	Northing	Easting	Northing	Easting	Northing	Easting
04200010	-0.189	-0.358	-0.491	-0.538	0.814	0.635
05171440	0.846	0.352	0.704	0.238	1.448	0.881
05200090	0.071	0.656	-0.357	0.520	1.010	1.529
07170830	0.307	-0.426	0.131	-0.729	1.074	0.169
08170130	0.487	-0.448	1.046	-0.990	1.283	0.071
08200010	-0.336	-0.009	0.042	0.213	0.689	0.690
Average:	0.198	-0.039	0.179	-0.214	1.053	0.662
RMSE:	0.447	0.421	0.574	0.602	1.084	0.819

Open ArcToolbox and open the
Data Management Tools > Projections and Transformations > Project tool:



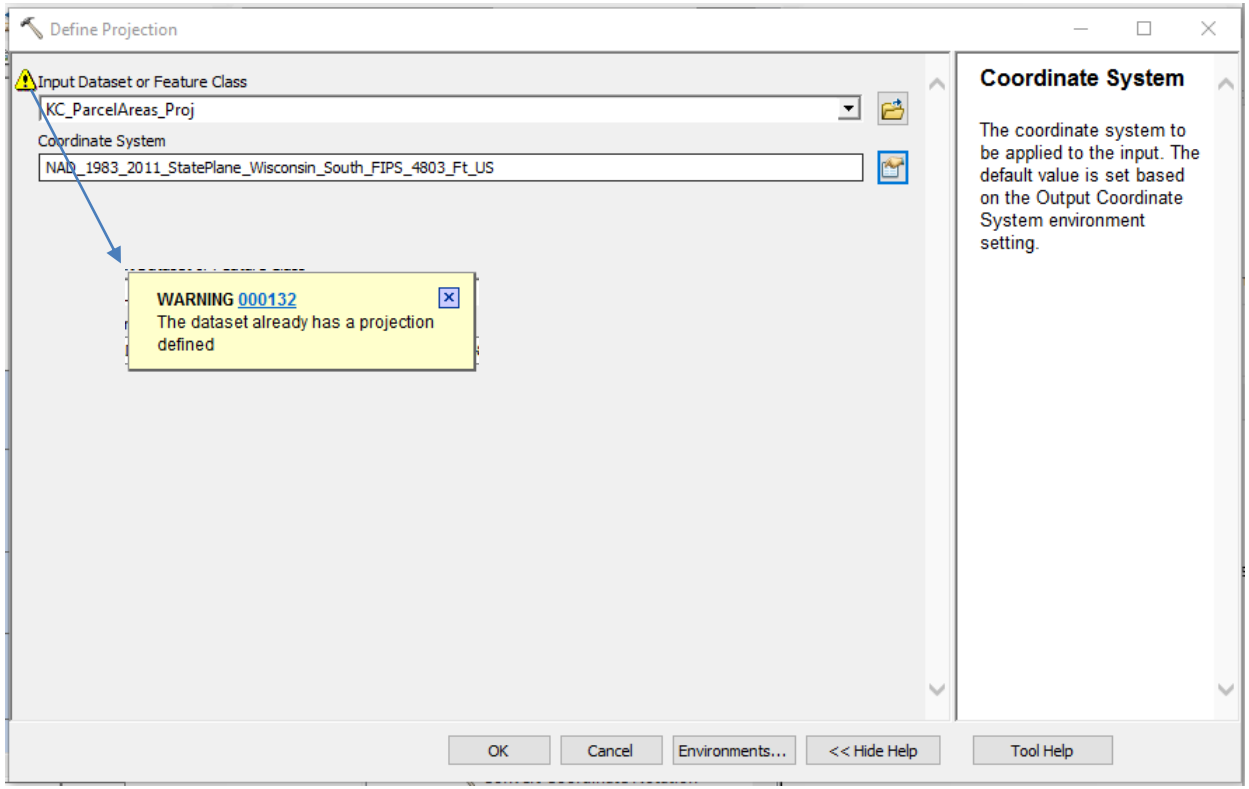
Caution: ArcCatalog – Stock Transformations

In the Project tool dialog box: Choose your input dataset, output dataset,
Input: **NAD_1927_StatePlane_Wisconsin_South_FIPS_4803** (greyed out)
Output: **NAD_1983_HARN_StatePlane_Wisconsin_South_FIPS_4803_Feet**
Geographic Transformation: **NAD_1927_To_NAD1983_NADCON + NAD_83 To_HARN_Wisconsin** (Note: This is extremely critical to successfully transformation your data from NAD27 to NAD83)



Open ArcToolbox again and open the Data Management Tools > Projections and Transformations > Define Projection tool.

Select your output file from the Project tool as your input dataset and select **NAD_1983_2011_StatePlane_Wisconsin_South_FIPS_4803_Ft_US** as your Coordinate System. (Note: You will see a warning that the dataset already has a defined projection)



Southeastern Wisconsin Regional Planning Commission

SEWRPC

Thank You - Questions